(12) UK Patent Application (19) GB (11) 2 169 724 A

(43) Application published 16 Jul 1986

(21) Application No 8500631

(22) Date of filing 10 Jan 1985

(51) INT CL⁴
B05B 12/02.

(52) Domestic classification (Edition H):
G3N 265A 281B GCA5B
U1S 1663 G3N

(56) Documents cited
EP A1 0109077 US 4389971 US 4164001

(58) Field of search
G3N
Selected US specifications from IPC sub-class B05B

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(54) Timing control system

(57) A system for use in automatic spray booths controls the operation of guns 16,18 in response to sensor 54 detecting objects to be sprayed upstream of the booth and sensor 60 detecting the speed of a track conveying the objects to the booth.

As shown whilst an object is passing sensor 54, pulses are cloocked into register 74 via switch 80. Whilst the track is moving these pulses are shifted through the register. The guns 16,18 are connected to outputs corresponding to their distance from the sensor 54, thus they are energised as the object reaches them.

Timers 96 permit the guns to be started and spray stabilised before an object reaches them.

An auxiliary spray gun can be controlled for a set period determined by timer 110 and initiated by logic 114.

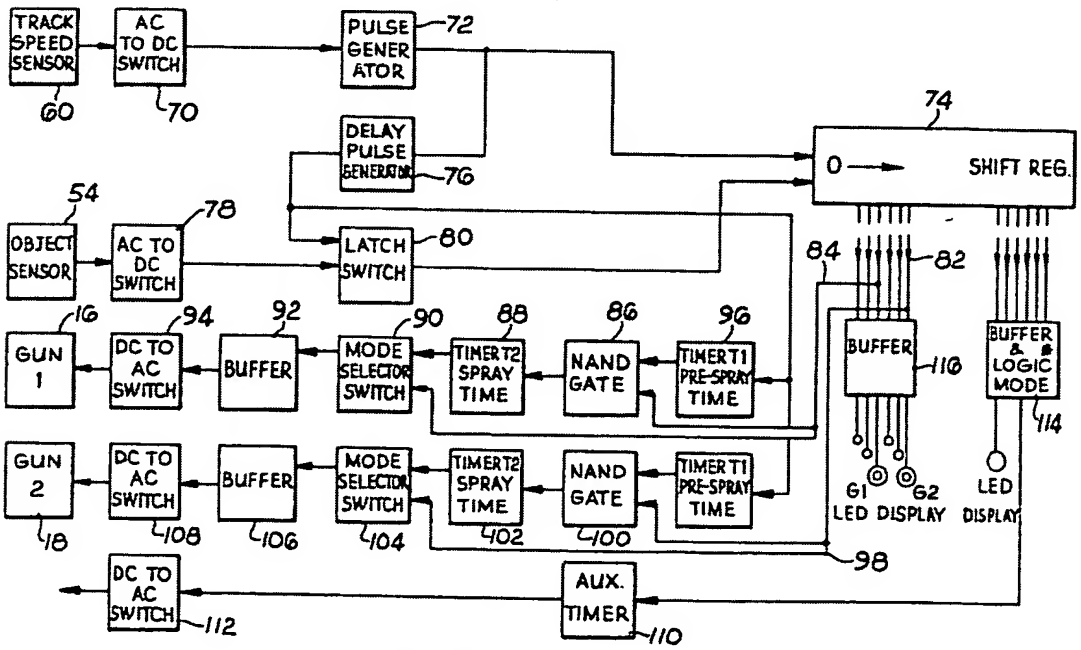

Fig. 4

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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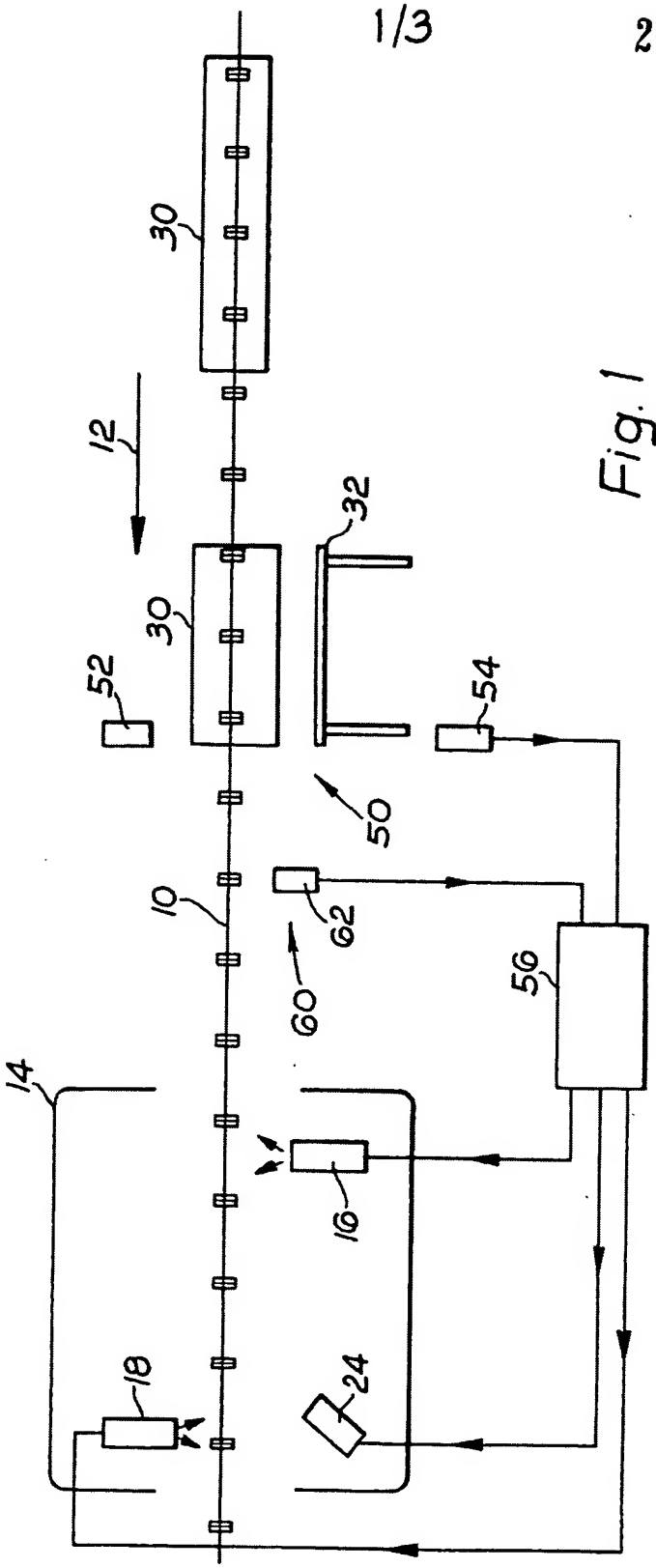

Fig. 1

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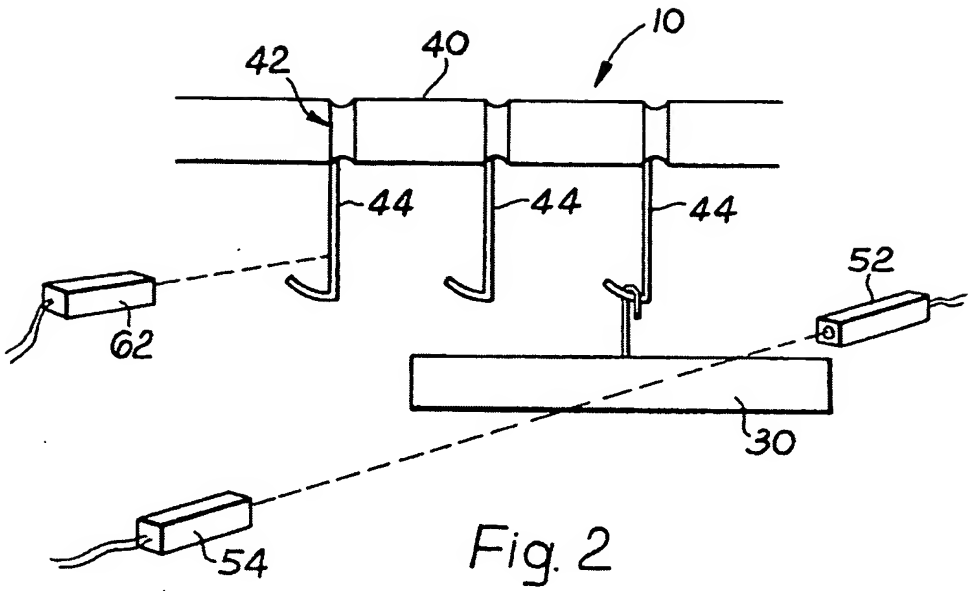

Fig. 2

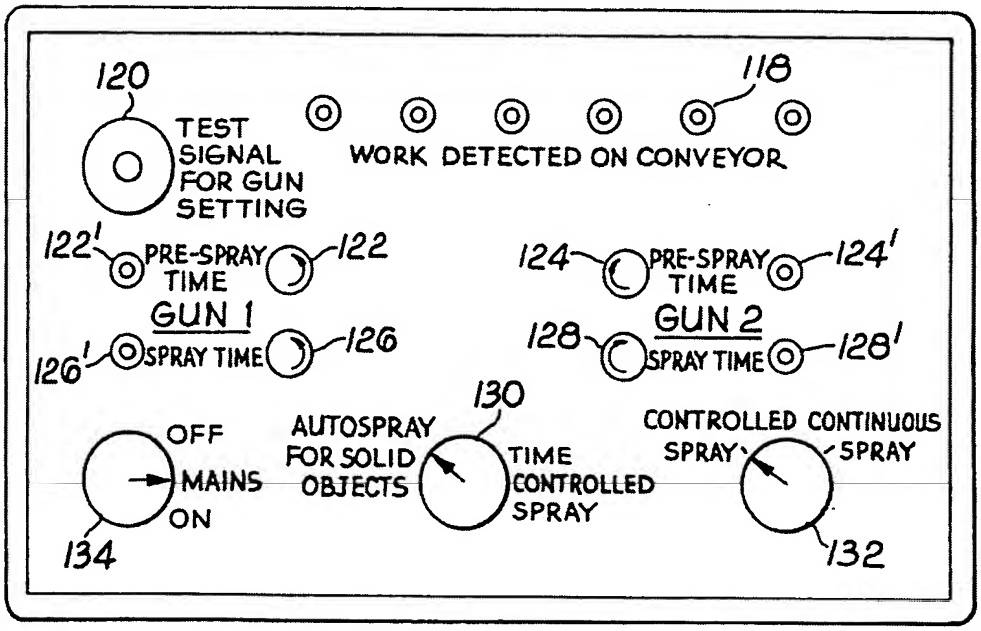

Fig. 3

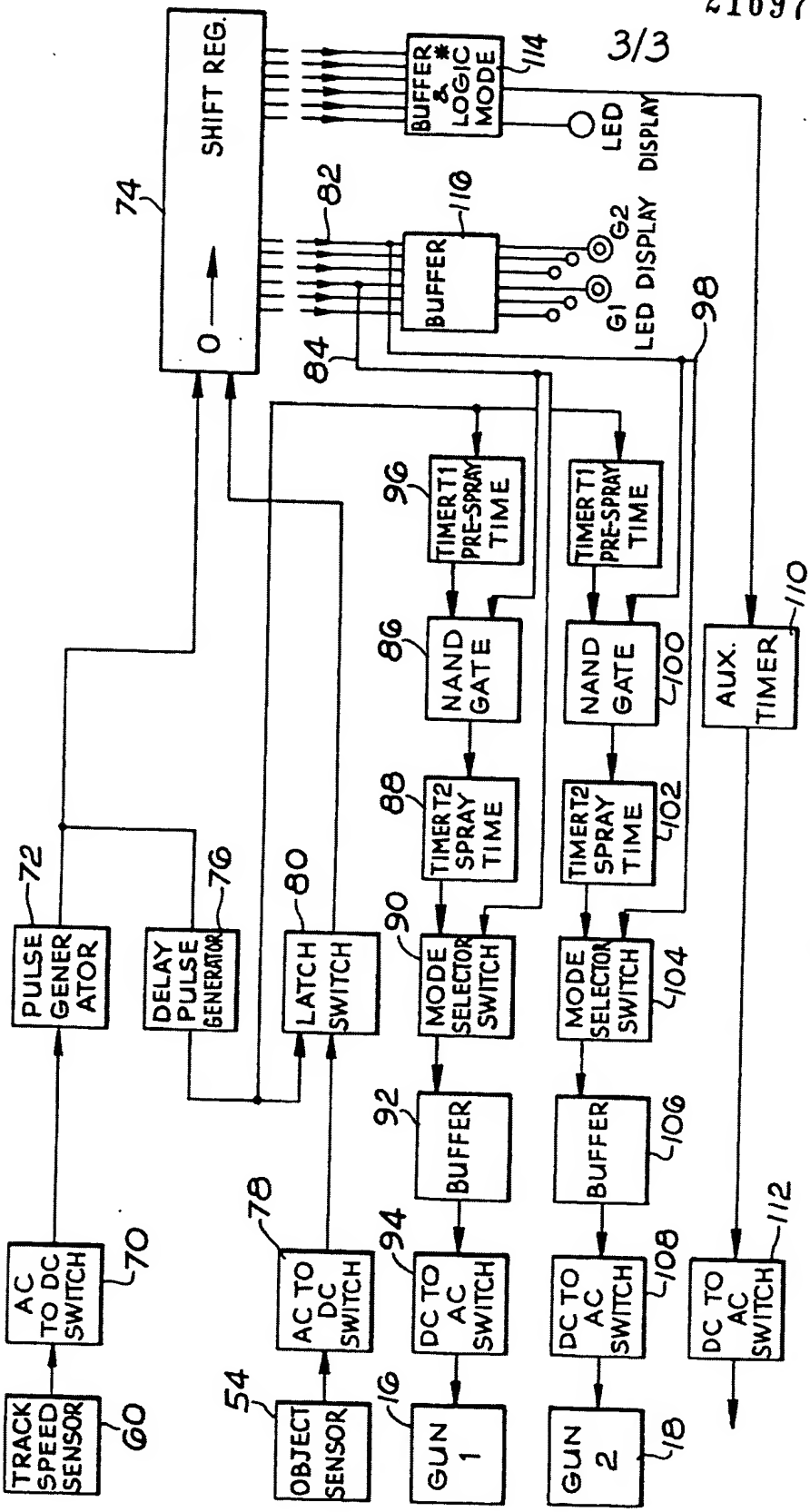
SHIFT REG.
74
0
BUFFER & LOGIC MODE
114
LED DISPLAY
82
BUFFER
110
G2
G1
LED DISPLAY
98
84
TIMER T1 PRE-SPRAY TIME
96
TIMER T1 PRE-SPRAY TIME
NAND GATE
86
NAND GATE
100
AUX. TIMER
110
TIMER T2 SPRAY TIME
88
TIMER T2 SPRAY TIME
102
PULSE GENER ATOR
72
DELAY PULSE GENERATOR
76
LATCH SWITCH
80
MODE SELECTOR SWITCH
90
MODE SELECTOR SWITCH
104
BUFFER
92
BUFFER
106
AC TO DC SWITCH
70
AC TO DC SWITCH
78
DC TO AC SWITCH
94
DC TO AC SWITCH
108
DC TO AC SWITCH
112
TRACK SPEED SENSOR
60
OBJECT SENSOR
54
GUN 1
16
GUN 2
18

Fig. 4

SPECIFICATION

Timing control system

The present invention relates to timing control systems and more particularly to timing control systems for spray guns. The timing control system finds particular application in spray booths in which one or more spray guns are positioned to spray objects carried by a conveyor through the spray booth.

In a first known system for spraying objects in a spray booth the spray guns are operative continuously whilst the conveyor is running. Thus any object entering the spray booth will be automatically sprayed completely. The disadvantage of this system is that it is extremely wasteful in the paint or like material being sprayed especially where the conveyor is lightly loaded with long gaps between objects.

A second known system incorporates a detector to detect objects to be sprayed as they enter or are about to enter the spray booth and turns on the sprayers for a defined period. Thus the sprayers are not operative during periods when there are long gaps on the conveyor system. A first disadvantage of this system is that the detector must be placed fairly close to the spray booth and is therefore subject to fairly hazardous environmental conditions (dirt, paint spray, temperature, humidity etc). A second disadvantage is that if a plurality of spray guns are used in the spray booth and the conveyor varies in speed or stops altogether then a part of an object to be sprayed may not be uniformly sprayed thus requiring the object to be hand sprayed or reentered onto the conveyor system for complete respraying.

It is an object of the present invention to provide a control system suitable for a spray booth which obviates the disadvantages of the above described known systems whilst ensuring a reasonable usage of the sprayed material. Obviously a 100% usage of the sprayed material can not be achieved due to the possibility of a short start up spraying time for the spray gun to achieve its operational spray level and also because the object to be sprayed need not necessarily be solid.

According to the present invention there is provided a timing control system including means for detecting an object, means for detecting the speed at which the object to be sprayed approaches a first station and means for actuating the apparatus at the first station to perform an operation on the obejct as it passes the first station.

In a preferred embodiment the apparatus at the first station comprises spraying means which is operative to spray the object as it passes the first station.

The control system may include means for detecting the front and rear extremities of the object and may include timing means for operating the apparatus at the first station to operate for a time dictated by the means for detecting the front and rear extremities.

The control system may include timing means for initiating operation of the spraying means prior to the object being within range of the spraying means to allow the spraying means to achieve its operational level.

Preferably a second station is situated a predetermined distance from the first station, apparatus at the second station being also controlled to operate over a different time period to the apparatus at the first station to perform an operation on the object as it passes the second station.

Preferably the objects are carried by a conveyor the conveyor being provided with equispaced parts from which a timing signal can be obtained to indicate the speed of the conveyor. The equispaced parts may be pendant hooks from which the objects to be operated on are suspended.

The means for actuating the operation of the apparatus at the first or second station may include an electronic shift register and control logic.

Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows in plan view a timing control system according to the present invention used in combination with a spray booth;

Figure 2 shows a portion of the system of Figure 1 in elevational view;

Figure 3 shows the controller for the system of Figure 1; and

Figure 4 shows in block diagrammatic form the circuit diagram of the controller of Figure 3.

With reference to Figure 1, a conveyor 10, preferably of the endless loop type, conveys objects to be sprayed in the direction indicated by arrow 12 to a spray booth 14 equipped with first and second spray stations 16, 18.

A further auxiliary spray gun 24 may be positioned in the booth 14 to spray specific areas of the object to be sprayed, which areas are not covered by the spray stations 16, 18.

The object 30 to be sprayed may for example be a component part of a product or may be the total product. It may take the form of a fairly solid object such as shown at 30 in Figure 1 and Figure 2 or it may be in the form of for example a table with legs as shown at 32 in Figure 1. Different spraying techniques, as described hereinafter may be adopted for the different types of object to be sprayed.

With reference now to Figure 2, a part of the conveyor 10 is shown in greater detail. The conveyor comprises a series of links 40

flexibly joined by joining portions 42. At specified intervals pendants 44 are fixed to the links 40, the objects 30, 32 to be sprayed being hung on the pendants 44.

The electronic control system includes a first detector station 50 comprising a light source 52 and a detector 54 connected to a first input of a control unit 56. This first detector station, as shown in Figure 2 is set at a height to detect the objects to be sprayed. A second detector station 60 comprises a combined light source and detector 62 connected to a second input of the control unit 56.

The units at stations 50 and 60 could be exchanged. It is preferred to use the separate detector and source for detections of the objects since the objects may be awkwardly shaped and light may not reflect from them. The combined detector can detect light reflected from the pendants and will therefore give a series of pulses indicative of the speed of the conveyor.

The control unit 56 has at least first and second outputs to control the operation of of the spray stations 16, 18 and may have further outputs to control the auxiliary spray guns 24 etc.

In operation the conveyor movement is detected by detector 60 in a continuous manner, the pulses obtained from the detector 60 being used by control unit 56 as clock pulses. Thus no matter what speed the conveyor runs at the control unit is kept "in step" with the conveyor. If the conveyor stops, for faults, lunch breaks etc. then the control unit will sense this and control the spray stations/guns accordingly.

The control unit shown in Figure 3 may be operated in a number of different modes.

MODE A Simply switches the guns on continuously and ignores the size and loading of components on the conveyor. This mode is used mainly for gun setting and system checking.

MODE B The component piece is detected and measured some distance away from the booth. This information is remembered and then brought into use as the components enter the spray booth for spraying.

The memory function is duplicated so that in a back to back spray booth the spray stations may be off-set up to several feet apart but the precise gun timing will be maintained in relation to the component being sprayed. This mode of operation is ideal for most solid components varying in length and also hung at random intervals along the conveyor.

MODE C The work is detected as in Mode B but not measured.

At the appropriate time the 'component present' signal initiates a timing sequence which controls the length of spray and also the start position, this being duplicated for a second spray station.

The start position and spray times for both spray stations are totally independant of each other.

This mode is mainly used for spraying high volumes of identical components and also large tubular or framework fabrications such as 32.

Again in Mode C the components may be hung at random intervals along the conveyor.

In this mode where very precise spray control is used the auxiliary function can be used to control a separate spray gun for spraying localised areas only, that are not being covered by the main guns.

Should the conveyor stop for any reason the last spray cycle will be completed and the unit will then wait until the conveyor is restarted and carry on as normal without losing its timing.

Variations in conveyor speed will not effect Mode B but in Mode C the spray times will need to be adjusted to suit the new conveyor speed.

The system is housed in a strong metal box which ideally needs to be mounted somewhere in the spray booth area and requires a 240 volt mains supply.

The work sensing units 52, 54, 60 are readily clamped to a convenient point on the conveyor system and electrically plugged into the main control unit.

The control unit has three outputs capable of driving any device such as a solenoid valve, actuator etc. that requries 110/240 volts AC at 1 amp maximum.

With reference now to Figure 4 the output conveyor speed sensor 60 is connected to an A.C. to D.G. converter 70 the output of which is amplified by pulse generator 72 and used as a clock pulse input for a shift register 74. The output pulse from pulse generator 72 is also fed to a delay pulse generator 76 which provides a delayed clock pulse to operate the rest of the circuitry a short period after the shift register 74 has received the front edge of its clock pulse.

The object sensor 54 provides an output to energise an A.C. to D.C. switch 78 the output of which is latched in a clocked latch switch 80. The output of latch 80 is clocked into the shift register 74 by the next clock pulse. Whilst the object is passing detector 54 the sensor 54 will maintain its output and successive pulses will be clocked into register 74. The output from sensor 54 will cease once the object to be sprayed has travelled completely past the sensor and therefore the number of pulses present in shift register 74 will represent the length of the object in terms of the number of spaces between pendants that it occupies.

The pulses are shifted down the register 74

in time with the movement of the conveyor 10. By arranging the connections to the outputs 82 of the shift register 74 to be at a number of clock pulses "down" the shift register equivalent to the distance between the detector 54 and the spray stations 16 and 18 the spray station may be operated when the object reaches the spray stations.

The first output on line 84 is connected to a first NAND gate 86 the output of which is connected to a first timer 88. The output of timer 88 is connected in a first position of a mode selector switch 90 via a buffer 92 and a D.C. to A.C. switch 94 to operate the first spray station 16. A first pre-spray timer 96 is energisable by the delayed clock pulse from generator 76 to provide a start up time for the spray station.

The second output 98 is connected to a second NAND gate 100 in a second control chain similar to the chain for control of the first spray station 16, which controls the operation of the second spray station 18.

A third chain controls via an auxiliary timer 110 the auxiliary spray gun 24 via a D.C. to A.C. switch 112. The auxiliary timer 110 is energised by a decoded output from the shift register 74 decoded by a buffer and logic mode circuit 114. The auxiliary spary gun 24 can therefore be energised for a time set by the timer 110 at a time determined by the logic 114.

Alternatively the buffered and logic mode circuit 114 may be used in a reverse mode to detect the absence of components on the conveyor 10 by detecting the presence of for example six consecutive clock pulses without any object sensing pulses from sensor 54. On detection of such a gap in the conveyor the auxiliary function is operated. In this case the auxiliary function may be one or more air jet devices which are set, when operated, to provide blasts of air onto the nozzles of the spray guns to clear surplus powder from the guns.

A buffer circuit 116 is used to illuminate the indicator lamps as shown in Figure 3. Lamps 118 indicate the detection and progress of work on the conveyor. Button 120 is a test button for spray gun setting. Control knebs 122, 124 control the pre spray time for "guns" 1 and 2 at stations 16 and 18 respectively. These "guns" could be complex arrangements. Lamps 122', 124' show when the pre spray time is operative. Similarly control knobs 126, 128 and lamps 126', 128' control the spray time when a time controlled spray is selected by control knob 130. A control knob 132 is provided to allow continuous spray if desired or the controlled spray using the circuitry of Figure 4 according to the invention. An ON/OFF control 134 is provided.

As an alternative to spray guns at stations 16 and 18 radiant heaters may be provided to heat treat the objects as they pass each station.

CLAIMS

1. A timing control system for a spray booth including means for detecting an object, means for detecting the speed at which the object to be treated approaches a first station and means for actuating the apparatus at the first station to perform an operation on the object as it passes the first station.

2. A timing control system as claimed in Claim 1 in which the apparatus at the first station comprises spraying means which is operative to spray the object as it passes the first station.

3. A timing control system as claimed in Claim 1 or Claim 2 in which the control system may include means for detecting the front and rear extremities of the object to be treated and includes timing means for operating the apparatus at the first station to operate for a time dictated by the means for detecting the front and rear extremities.

4. A timing control system as claimed in any one of Claims 1 to 3 in which the control system includes timing means for initiating operation of the spraying means prior to the object being within range of the spraying means to allow the spraying means to achieve its operational level.

5. A timing control system as claimed in any one of Claims 1 to 4 including a second station situated a predetermined distance from the first station, apparatus at the second station being also controlled to operate over a different time period to the apparatus at the first station to perform an operation on the object as it passes the second station.

6. A timing controls system as claimed in any one of Claims 1 to 5 in which the objects are carried by a conveyor the conveyor being provided with equispaced parts from which a timing signal is obtained to indicate the speed of the conveyor.

7. A timing control system as claimed in Claim 6 in which the equispaced parts are pendant hooks from which the objects to be operated on are suspended.

8. A timing control system as claimed in any one of Claims 1 to 7 in which the means for actuating the operation of the apparatus at the first or second station includes an electronic shift register and control logic.

9. A timing control system as claimed in any one of Claims 1 to 8 including means for detecting the absence of an object for a predetermined time interval and means for actuating an auxiliary function.

10. A timing control system as claimed in Claim 9 in which the auxiliary function comprises means for introducing an air blast to clear surplus powder from spray guns.

11. A timing control system as claimed in Claim 1 in which the apparatus at the first station comprises heat treatment apparatus.

12. A timing control system substantially as described with reference to the accompanying drawings.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1986, 4235.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.